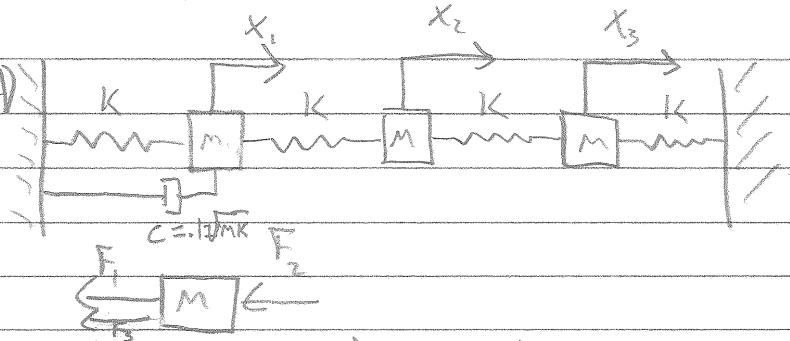
(34) A)



$$M\ddot{x}_1 = -Kx_1 + (x_2 - x_1)K - C\dot{x}_1$$
$$M\ddot{x}_1 + K(2x_1 - x_2) + C\dot{x}_1 = 0$$

$$M\ddot{x}_2 = -K(-x_2 + x_1) + (x_3 - x_2)$$
$$M\ddot{x}_2 + K(2x_2 - x_1 - x_3) = 0$$

$$M\ddot{x}_3 = K(x_2 - x_3) - Kx_3$$
$$M\ddot{x}_3 + K(2x_3 - x_2) = 0$$

$$\begin{bmatrix} M & 0 & 0 \\ 0 & M & 0 \\ 0 & 0 & M \end{bmatrix}\begin{bmatrix} \ddot{x}_1 \\ \ddot{x}_2 \\ \ddot{x}_3 \end{bmatrix} + \begin{bmatrix} C & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} + \begin{bmatrix} 2K & -K & 0 \\ -K & 2K & -K \\ 0 & -K & 2K \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = 0$$

See attached code

B) $\dot{Z} = \underbrace{\left[\begin{array}{c|c} 0 & I \\ \hline M^{-1}K & M^{-1}C \end{array}\right]}_{A} Z$

$Z = e^{\lambda t} \cdot V$ where λ is the eigenvalues of A and V is the matrix of eigenvectors.

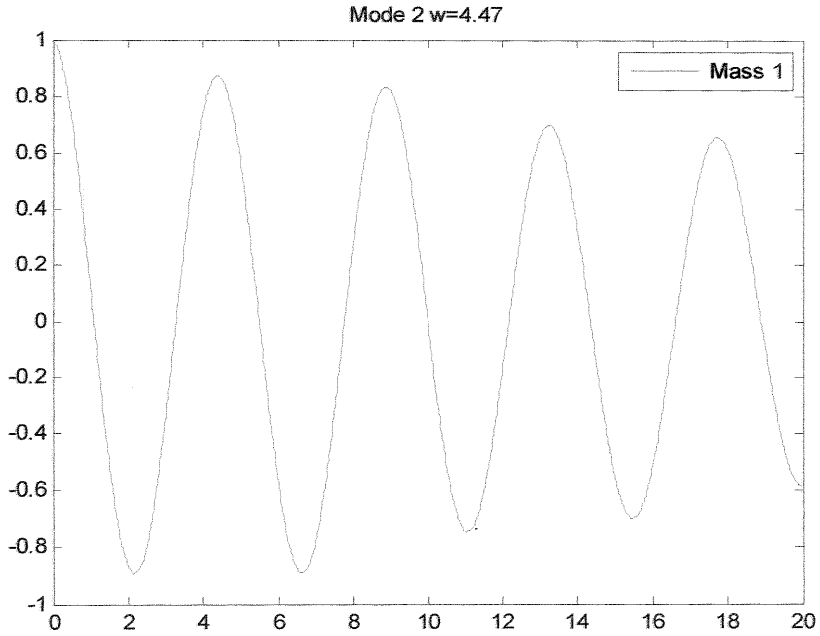
$$Z = \begin{bmatrix} V_1 & V_2 & V_3 & \cdots & V_6 \end{bmatrix}\begin{bmatrix} C_1 e^{\lambda_1 t} \\ C_2 e^{\lambda_2 t} \\ \\ C_3 e^{\lambda_3 t} \end{bmatrix} \qquad C = V^{-1} Z_0$$

The Matlab is trivial

C) This part is trivial

#34 (3/5)

A)




```
function Homework34()

%Parameters
m=1;
k=1
M = [ m 0 0; 0 m 0;0 0 m];
K = [2*k -k 0; -k 2*k -k;0 -k 2*k];
C=[.1*sqrt(k*m) 0 0; 0 0 0; 0 0 0];

%ICs:
%x0= [1 1.618]'; % initial position
x0= [1 0 -1]'; % initial position
v0=[ 0 0 0]'; % initial velocity
zzero= [x0;v0];

n= 1000;

tspan = linspace(0, 20, n)

%Method I: ODE soln
[t zmatrix] = ode45(@rhs, tspan, zzero, [], M,K,C );
  x1 = zmatrix(:,1);
  x2 = zmatrix(:,2);
  x3 = zmatrix(:,3);

  figure(1)

  plot (t,x1);  title('Mode 2 w=4.47')
```

```
  legend('Mass 1')


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
function zdot = rhs(t,z,M,K,C)
x = z(1:3);
v = z(4:6);

xdot = v;

vdot = -M^-1 * (K*x+C*v);


zdot = [xdot; vdot];

end
```